COMPARISON OF THE CUTTING FORCE, POWER, TOOL LIFE AND TORQUE IN THE END MILLING OF MODIFIED AISI P20 TOOL STEEL

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A report submitted in partial fulfilment of
The requirements for the award of the degree of
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With Manufacturing Engineering

Faculty of Mechanical Engineering
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EXAMINERS APPROVAL DOCUMENT

UNIVERSITI MALAYSIA PAHANG
FACULTY OF MECHANICAL ENGINEERING

We certify that the project entitled "*Comparison of the cutting force, power, tool life, and torque in the end milling of modified AISI P20 tool steel"* is written by *P.VINOTH A/L S PARAWAKARAN*. We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering.

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Date : November 2009

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I declare that this thesis entitled *"Comparison of the cutting force, power, tool life, and torque in the end milling of modified AISI P20 tool steel"* is the result of my own research except as cited in the references. The thesis has not been accepted for my degree and is not concurrently candidature of any other degree.

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Date : ……..

This work is dedicated to my beloved ones,

My Father Mr. Parawa Karan

My Mother Mrs. Kamal Thevi

My Sisters Ms Reetha Parawa Karan

And

Allies…

Thank you for the endless support and encouragement.

You all always have a special place in my heart.

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ABSTRACT

The aim of this study is to make comparison of the cutting force, power, torque and tool life in the end milling of modified AISI P20 tool steel with aid of statistical method by using coated carbide cutting tool under various cutting conditions. The first and second order cutting force equations are developed using the response surface methodology (RSM) to study the effect of four input cutting parameters which is cutting speed, feed rate, radial depth and axial depth of cut on cutting force, power, torque and tool life.

In general, the result that been obtained from the mathematical model are in good agreement with that obtained from the experiment data's. It was found that the feed rate, cutting speed, axial depth and radial depth played a major role in determining the cutting tools. The predictive models in this study are believed to produce values of the longitudinal component of the cutting force close to those readings recorded experimentally with a 95% confident interval.

ABSTRAK

Tujuan kertas kerja bagi project ini adalah membincangkan perbandingan antara kuasa potongan, kekuatan, kalungan potongan dan janka hayat peralatan yang dihasilkan dalam operasi hujung kisaran terhadap modifikasi AISI P20 alatan besi.

Persamaan pertama dan kedua dalam sususan peralatan potangan telah dikembangkan dengan menggunakan keadah tindakbalas permukaan yang dipelajari daripada kesan terhadap empat jenis pengeluar pemotongan. Iaitu kelajuan pemotongan, kadar pembekal, kedalaman axial dan radial terhadap kekuatan pemotongan. Kecerunan pemotongan yang berkait dengan parameter pengeluar telah dibentangkan dan model yang dijangkakan.

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LIST OF SYMBOLS

a_e	Effective rake angle	-
Q	Volume that been removed	-
K	Dimension Quantity	-
H	Indention hardness	-
W	loading	-
L	Sliding distance	-
F	cutting tools (response)	-
A, B, C, D and E	constant value	-
V_c	Cutting speed	m/min
f	feed rate	mm/rev
a_a	axial depth	mm
a_r	radial depth	mm

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Machining is very important in the manufacturing process. But now days, many manufacturing companies were often facing problem in setting the machine tools. For that problem, manufacturing engineers and research have been realizing that in order to optimize the economic performance of metal cutting operations, efficient quantitative and predictive model that establish the relationship between a big groups of input independent parameter and output variable are required for the wide spectrum of manufacturing process, cutting tools and engineering materials currently use in the industry. Efforts to further improve and optimize machining time and costs by reliable estimation of performance features such as force, power, tool life, temperature and surface finish is increasing to become important in modern manufacturing industry (V. Karri and H. Talhami, 1995). The aim of the project is to develop the first and second order power, force, tool life and torque model when machining modified AISI P20 tool steel and also to safe the cutting cost and production time.

1.2 PROBLEM STATEMENT

When doing machining process, the tool cutting ability will degrades with time, until in certain time, the tool can no longer cut through the material. Certain conditions affect the tool life, power, force, torque when it was not suitable for the tools. Certain conditions affect the tool life, power, force, and torque when it was suitable for the tools.

So that, we need have a solution in the beginning to solve this type of problem. To solve the problem, cutting tools user need to have a mathematical model that can help them to predict the power, force, tool life and torque by calculation. Therefore the cutting tools users need to have a mathematical model that can help to predict the force, power, and torque and tool life by calculation. From this way, we can prevent the cutting tool from damage at the short period of time. For that, there will be several experiments to gain the need data.

For this project, we need to run 27 experiments with different range of parameters. There will four type of parameters been selected in this experiment. There are cutting speed, the fed rate, radial depth and the axial depth. This project will use coolant and the material hat been use for experiments is modified AISI P20 tool steel. Other than that, the type of cutting tool that been use for this experiments is TiN coated inserts. To run the experiments, we need computer numerical control, and CNC machine. At the end of the experiment, there will be two mathematical models been use. There are the first order and the second order.

1.3 OBJECTIVE

The objective of this study is:

1. To predict the cutting force, power, torque and tool life in the end milling operation of modified AISI P20 tool Steel.

2. To make the comparison about the cutting force, power, tool life and torque in the end milling.

1.4 LIMITATION

The develop models got its own limitation which are the range of cutting speed is between 100 to 180 m/min, the federate between 0.1 to 0.2 mm/rev, the axial depth between 1 to 2mm and the radial depth between 2 to 5mm.

Table 1.1: Parameters range:-

Level	Low	Med	High
coding / Factors	-1	0	1
Cutting speed (m/s)	100	140	180
Feed rate (mm/rev)	0.1	0.2	0.3
Axial depth (mm)	1	1.5	2
Radial depth (mm)	2	3.5	5

1 .5 THESIS OUTLINE

Chapter 1:

- In chapter, we tell about the project mainly. In here, we talk about the problem of the project, the objective of the project, and the project scope.

Chapter 2:

- In this chapter, we talk about the literature review the project. In the literature review, we tell about the wear mechanism, CNC Milling machine, and other topic that related to the project.

Chapter 3:

- Chapter 3 mainly about the project methodology. We will discuss about the project flow chart and the parameter that been use for the project. This is very important because it will show a draft of the experiment.

Chapter 4:

- In this chapter, we will talk about the research result and discussions. In result, we will tell about overall of the experiment result and show the way that the result been gain. Then, we will discuss about that and tell the way to improve it.

Chapter 5:

- Chapter 5 mainly about the conclusion of the project. In here, we will tell about the overall of the project and conclude it.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

There are many type of angle been taken to analyze in wear mechanism in aspect of advance of material, surface engineering and lubricants. Other than that, we also must consider in aspect of design methods and condition monitoring for improving the wear mechanism in cutting tools and the efficiency. As an engineer, we need do more development and challenge in tribology in the wear mechanism field.

As a basic machining process, milling is a one of the widely been used in industry as metal removed process. Milling surface are larger used to mate with other parts in die, aerospace, automotive and machining design as well as in manufacturing in industry. In this research the wear mechanism maps of carbide tools of milling is constructed by many condition of tools material, machined material and machining parameter. In this research, w also discussed about optimizes the machine and choosing the suitable milling parameter of the carbide tools.